PLATE AND TUBE BENDING DEVICE

BACKGROUND OF THE INVENTION

1) FIELD OF THE INVENTION

The invention herein relates to forming jigs and fixtures, specifically a plate and tube bending device capable of absorbing shock from the force generated while a workpiece is being bent to uniformly disperse force exerted on the workpiece, completely preventing situations occurring due to concentrations of applied force such that the workpiece is formed with precision at a predetermined angle of bend, with the workpiece surface remaining smooth and free of pressure marks.

2) DESCRIPTION OF THE PRIOR ART

There are three types of bending methods utilized by existent plate and tube bending devices:

One, as indicated in FIG. 1-A, is stretch bending in which the chucks A1 of the plate and tube bending device A hold the two extremities of a workpiece B, with a form block A2 disposed on the plate and tube bending device A serving as the axial center around which the chucks A1 flex the workpiece B to a predetermined angle of bend.

Another, as indicated FIG. 1-B, is draw bending in which the pressure bar A3 of the plate and tube bending device A bears down against one extremity of the workpiece B to be finished into a certain curvature and the other extremity is held between the form block A2 and the clamp A4, the form block A2 and the clamp A4 then function simultaneously to flex the workpiece B to a predetermined angle of bend.

Yet another, as indicated in FIG. 1-C, is compression bending in which after the clamp A4 of the plate and tube bending device A clinches one extremity of the workpiece B to be finished into a certain curvature, the other extremity is held in the form block A2 and the clamp A4, but only the clamp A4 flexes the workpiece B to a predetermined angle of bend.

However, when the said three types of bending methods are utilized by the plate and tube bending devices A to shape the workpiece B to a predetermined angle of bend, since force is generated when the workpiece B being bent between the chucks A1, the pressure bar A3, the clamp A4 of the plate and tube bending devices A and the chucks A1, the pressure bar A3, the clamp A4 are incapable of uniformly dispersing and absorbing the

shock of such applied forces, this often results in the impossibility of forming the workpiece B to a predetermined angle of bend and, furthermore misshaping and surface wear problems occur that affect the workpiece 5 finished product quality and there are also fitting problems when assembled with other components.

Referring to FIG. 1-C (compression bending), after the clamp A4 of the plate and tube bending device A clinches one extremity of the workpiece B to be finished into a certain curvature, the other extremity is held in the form block A2 and the clamp A4, and when the clamp A4 flexes the workpiece B to a predetermined angle of bend, due to the large force applied by the clamp A4 to bend the workpiece B, the applied force accompanying the action of the clamp A4 produces dislocation to flex the workpiece B at the bending moment, the force exerted totally utilized to bend the workpiece B.

However, when the applied force accompanying the clamp A4 dislocation becomes capable of flexing the workpiece B at the bending moment, i.e., when the bending of the workpiece B is due completely to the action of the clamp A4, the clamp A4 lacks any shock absorption structure to uniformly disperse force applied to the workpiece B, resulting in concentrations of force as the workpiece B is bent, causing the misshaping of the workpiece B after bending (especially at the bend of the workpiece B); with no accurate control over the degree of precision, the quality of the workpiece B finished product is adversely affected and fitting problems occur when assembled with other components.

In addition, when the action of the clamp A4 produces dislocation, the clamp A4 moves against the surface of the workpiece B, easily causing wear and abrasion of the workpiece B surface that affects the appearance of the workpiece B.

Therefore, the applicant of the invention herein, in view of the said structural shortcomings and based on a penetrating understanding based on many years experience gain while engaged in the relevant fields as well as from market surveys and sales responses along with the continuous analysis of the research results which culminated in the successful development of the content of the present invention which is submitted as a new patent application.

SUMMARY OF THE INVENTION

The primary objective of the invention herein is to provide a plate and tube bending device in which a workpiece is held between the forming die and the secondary clamp block of a plate and tube bending fixture, with a primary clamp block also maintaining position such that the workpiece is held very firmly in the plate and tube bending fixture for facilitating the next bending fabrication task; when the primary clamp block of the plate bending fixture is rotated to achieve a bending moment in the workpiece, the workpiece is bent until the primary clamp block revolves to a top point where rotation ceases and the workpiece is formed exactly into the expected angle of bend; at the same time, the primary clamp block cushioning mount has shock absorbing springs inside and the pressure cylinder mount absorbs shock from the force generated when force is applied to the workpiece during bending which is uniformly dispersed by the primary clamp block such that the workpiece is formed precisely at the expected angle of bend, with the workpiece surface remaining smooth and free of pressure marks.

Another objective of the invention herein is to provide a plate and tube bending device in which after a workpiece held between the forming die and the secondary clamp block of a plate and tube bending fixture, the pressure cylinder piston rod of the primary clamp block extends out synchronously such that the piston rod end head linked by means of an inserted pin between the connecting rod assembly and the connecting rod assembly said paired connecting rod element assemblies as well as the connecting rod guide element mount ensconced between the bottom ends of each said paired connecting rod element assemblies move synchronously, impelling the said connecting rod guide element mount fitted in the two inner side surfaces of the guide slots along the lower half portion of the clamp block mount containing room into a guided slide, causing the piston rod to very smoothly and stably extend and retract, the piston rod continuing to extend causing the end head linked by means of the inserted pin between the connecting rod assembly to synchronously move until the guide track formed along the two sides at the bottom surface of the guide track mount in coordination with the guide track slot mount having the inset guide slot along the connecting rod mount upper end mount surface of the connecting rod assembly enables the cushioning mount to fully clamp the workpiece, thereby completing the clamped positioning of the workpiece and facilitating the next bending fabrication task of the workpiece.

To enable a further understanding of the structural features and operation of the present invention, the brief description of the drawings below are followed by the detailed description of the invention herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1-A is an orthographic drawing of a conventional plate and tube bending device.

Figure 1-B is an orthographic drawing of another conventional plate and tube bending device.

Figure 1-C is an orthographic drawing of yet another conventional plate and tube bending device.

Figure 2 is an isometric drawing of the plate and tube bending device primary clamp block of the invention herein.

Figure 2-A is an exploded drawing of the said main clamp block.

Figure 2-B is a cross-sectional drawing of the said primary clamp block, as viewed from the front.

Figure 2-C is a cross-sectional drawing of the said primary clamp block, as viewed from the side.

Figure 2-D is an isometric drawing of the said primary clamp block.

Figure 3 is an exploded drawing of the cushioning mount.

Figure 3-A is a drawing of the cushioning mount backing plate, as viewed from the rear.

Figure 4-A is an exploded drawing of the primary clamp block pressure cylinder mount.

Figure 4-B is an isometric drawing of the primary clamp block pressure cylinder mount.

Figure 5-A is a cross-sectional drawing of the primary clamp block in the workpiece bending operation of the most preferred embodiment.

Figure 5-B is a cross-sectional drawing of the primary clamp block in workpiece bending operation of the most preferred embodiment.

Figure 5-C is a cross-sectional drawing of the primary clamp block in the workpiece bending operation of the most preferred embodiment.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 2, FIG. 2-A, FIG. 2-B, FIG. 2-C, FIG. 2-D, FIG. 3, FIG. 3-A, FIG. 4-A, and FIG. 4-B, the plate and tube bending device of the invention herein is a plate and tube bending fixture 1 forming die 2 as well as a primary and a secondary clamp block 3 and 4 that bends a workpiece 5 into an end product having a predetermined angle of bend; the said forming die 2 has a clamp surface and contouring plate workpiece 5 forming surfaces, the clamping surfaces between the said forming die 2 and the secondary clamp block 4 are utilized to hold the workpiece 5, with the primary clamp block 3 also utilized to hold the workpiece 5, and the primary clamp block 3 consists of a clamp block mount 6, cushioning mount 7, and a pressure cylinder mount 8, wherein:

The said clamp block mount 6 has a containing room 61 formed as an opening through it and a groove 62 is disposed at the upper half portion in each of the two sides, enabling the cushioning mount 7 to fit in for guided sliding outside the clamp block 6, spring mounts 6A are situated in a parallel arrangement between two end plate 63 outer lateral planar surfaces and the groove 62 bottoms, a screw 6B is fastened to one end of each spring mount 6A to provide for hooking one extremity of a return spring 6C, a notch 64 is formed in each of the two end plates 63 at the other ends of the spring mounts 6A without screws 6B, such that the screws 6B in the two side surfaces of a guide track mount 7A protruding through the notches 64 outside the two end plates 63 facilitate the hooking on of the other extremities of the return spring 6C, with the thereby springs 6C positioned at the outer lateral planar surfaces of the two end plates 63.

The said cushioning mount 7 consists of the guide track mount 7A and a backing plate 7B; threaded holes 7A1 are tapped symmetrically into the two end surfaces of the cushioning mount 7, screws 7C are individually inserted through a check block 7D and fastened into the threaded holes 7A1 position and at the same time, the check block 7D bottom surfaces make even contact against the groove 62 bottom surfaces, providing for the guided sliding of the cushioning mount 7, a predetermined quantity of spring holes 7A2 are arrayed in a set formation on the mount surface of the guide track mount 7A and circular holes 7A3 penetrate the guide track mount 7A, a spring 7E is placed in each of the spring holes 7A2, and the predetermined quantity of circular holes 7A3 in the mount surface of the guide track mount 7A and a predetermined quantity of threaded holes 7B1 arrayed in a set formation along the rear surface of the backing plate 7B are all in

symmetrical alignment, a predetermined quantity of screws 7F are upwardly inserted through the circular holes 7A3 from the bottom surface of the guide track mount 7A and fastened into the correspondingly positioned threaded holes 7B1 of the backing plate 7B, providing the entire cushioning mount 7 with shock absorbing capability to evenly vector applied force via the primary clamp block 3 to bend the workpiece 5, and a guide track 7A4 is formed along the two sides at the bottom surface of the guide track mount 7A which fits the inset guide slot 8C1 of the guide track slot mount 8C disposed along the top surface of the pressure cylinder mount 8 such that the cushioning mount 7 has guided sliding capability.

The said pressure cylinder mount 8 consists of a pressure cylinder 8A, a connecting rod assembly 8B, and the guide track slot mount 8C; the said pressure cylinder 8A is fastened with screws 6E onto the bottom cover 6D at the bottom end of the clamp block mount 6, and the connecting rod assembly 8B is inserted into the piston rod 8A1 rod head 8A2 of the pressure cylinder 8A; the connecting rod assembly 8B consists of paired connecting rod element assemblies 8B1, a long connecting rod block 8B2, a connecting rod mount 8B3, and a connecting rod guide element mount 8B4, the two ends of the said pressure cylinder 8A piston rod 8A1 rod head 8A2 are linked between the pair of connecting rod element assemblies 8B1 by means of an inserted pin 8D, enabling each said pair of connecting rod element assemblies 8B1 to be inserted in parallel at the two ends of the rod head 8A2, one connecting rod guide element mount 8B4 is ensconced between the bottom ends of each said paired connecting rod element assemblies 8B1, the long connecting rod block 8B2 ensconced between the upper ends and linked by means of the inserted pin 8D, the said connecting rod guide element mount 8B4 then capable of fitting into the two inner side guide slots 65 along the lower half portion of the clamp block mount 6 containing room 61, as the pressure cylinder 8A piston rod 8A1 extends out and retracts in a guided sliding movement inside the guide slot 65, the upper half portions of the long connecting rod block 8B2 ensconced between the upper ends of the said paired connecting rod element assemblies 8B1 then projects on the paired connecting rod element assemblies 8B1, facilitating the insertion and linking of pivot tabs protruding downward from all sides along the bottom surface of the connecting rod mount 8B3 to the long connecting rod block 8B2 by means of the inserted pin 8D; a plurality of bearings 8E and the guide track slot mount 8C are sequentially disposed facing upward on the upper end

mount surface of the connecting rod mount 8B3, the bearings are of wear-resistant, low hardness copper material construction that have durable and smooth guided sliding capability, and the guide track slot mount 8C has the inset guide slot 8C1 that accommodates the guide track 7A4 formed along the two sides at the bottom surface of the guide track mount 7A, thereby enabling the conjoinment of the pressure cylinder mount 8 and the cushioning mount 7.

Referring to FIG. 5-A, FIG. 5-B, and FIG. 5-C, the clamping into position of the workpiece 5 by the present invention: after the workpiece 5 is clamped between the clamping surfaces of the forming die 2 and the secondary clamp block 4 of the plate and tube bending fixture 1 of the invention herein, the pressure cylinder 8A piston rod 8A1 extends out synchronously such that the piston rod 8A1 end head 8A2 linked by means of the inserted pin 8D between the connecting rod assembly 8B and the connecting rod assembly 8B said paired connecting rod element assemblies 8B1 as well as the connecting rod guide element mount 8B4 ensconced between the bottom ends of each said paired connecting rod element assemblies 8B1 synchronously move the primary clamp block 3, impelling the said connecting rod guide element mount 8B4 fitted in the two inner side surfaces of the guide slots 65 along the lower half portion of the clamp block mount 6 containing room 61 into a guided slide, causing the piston rod 8A1 to very smoothly and stably extend and retract, the piston rod 8A1 continuing to extend causing the end head 8A2 linked by means of the inserted pin 8D between the connecting rod assembly 8B to synchronously move until the guide track 7A4 formed along the two sides at the bottom surface of the guide track mount 7A in coordination with the guide track slot mount 8C having the inset guide slot 8C1 along the connecting rod mount 8B3 upper end mount surface of the connecting rod assembly 8B enables the cushioning mount 7 to fully clamp the workpiece 5, thereby completing the clamped positioning of the workpiece 5 and facilitating the next bending fabrication task of the workpiece 5.

Additionally, the said workpiece 5 is clamped into position between the forming die 2 and the secondary clamp block 4 as well as also clamped into position by the primary clamp block 3, enabling the workpiece 5 to be extremely firmly positioned on the plate bending fixture 1 for the execution of bending fabrication tasks and, thus, when the primary clamp block 3 of the plate bending fixture 1 is rotated to achieve a bending moment in the workpiece 5, the workpiece 5 is bent until the primary clamp block 3

revolves to a top point where rotation ceases and the workpiece 5 is formed exactly into the expected angle of bend, with the workpiece surface remaining smooth and free of pressure marks.

When the primary clamp block 3 of the plate bending fixture 1 invention herein is rotated by the plate bending fixture 1, the operation of the primary clamp block 3 is as follows, referring to FIG. 5-A, FIG. 5-B, and FIG. 5-C:

The primary clamp block 3 is turned as the plate bending fixture 1 is rotated, at which time the primary clamp block 3 cushioning mount 7 is subjected to gravitational force, causing the guided sliding of the cushioning mount 7 via its guide track 7A4 formed along the two sides at the bottom surface of the guide track mount 7A in coordination with the guide track slot mount 8C inset guide slot 8C1 at the top surface of the pressure cylinder mount 8 and then in a guided slide move out of the clamp mount block 6 from the containing room 61 inside the clamp mount block 6 along the grooves 62 at the upper half portion of the two sides of the clamp block mount 6 until the primary clamp block 3 revolves to the top point and ceases rotation; the entire cushioning mount 7 does not traverse the guide track slot mount 8C inset guide slot 8C1 at the top surface of the pressure cylinder mount 8 in a guided slide, at which time the return spring 6C hooked between the screw 6B fastened at one end of the two end plate 63 outer lateral planar surfaces of the spring mount 6A and the screws 6B in the two side surfaces of the guide track mount 7A of the cushioning mount 7 is subjected to the guided slide of the cushioning block 7 in the guide track slot mount 8C inset guide slot 8C1 and drawn into extension, since the retracting force of the extended return spring 6C pulls the cushioning mount 7 in the guided slide back once again to its original position, the restoral to original position occurring by guided sliding along the grooves 62 at the upper half portion of the two sides of the containing room 61 into the clamp block mount 6 containing room 61 position.

At the same, when the drawn return spring 6C restoring force causes the guided sliding cushioning mount 7 back once again to its original position by a guided slide into the clamp block mount 6 containing room 61 position, screws 7C in the end surfaces of the cushioning mount 7 guide track mount 7A fasten the check block 7D such that it makes even contact against the bottom surfaces of the grooves 62, enabling the guided sliding of the cushioning mount 7 such that it is locked in place when restored back to the

clamp block mount 6 containing room 61 position.

A feature of the invention herein is that when the plate bending fixture 1 vectors an applied force to bend the workpiece 5, the primary clamp block 3 uniformly disperses, neutralizes, and absorbs shock accompanying the exertion of force, completely preventing situations occurring due to concentrations of applied force and the workpiece 5 is formed with precision into the expected angle of bend, the uniform dispersal, neutralization, and absorption of shock by the primary clamp block 3 during the forced bending of the workpiece due to the functions of the cushioning mount 7 and the pressure cylinder mount 8.

The cushioning mount 7 consists of a guide track mount 7A and a backing plate 7B.

The said guide track mount 7A has a predetermined quantity of spring holes 7A2 are arrayed in a set formation on its mount surface as well as circular holes 7A3 that penetrate the guide track mount 7A, a spring 7E is placed in each of the spring holes 7A2, and the predetermined quantity of circular holes 7A3 in the mount surface of the guide track mount 7A and a predetermined quantity of threaded holes 7B1 arrayed in a set formation along the rear surface of the backing plate 7B are all in symmetrical alignment, a predetermined quantity of screws 7F are upwardly inserted through the circular holes 7A3 from the bottom surface of the guide track mount 7A and fastened into the correspondingly positioned threaded holes 7B1 of the backing plate 7B, to conjoin the guide track mount 7A and the backing plate 7B into a single structural entity, while the backing plate 7B bottom surface is against the springs 7E in the spring holes 7A2 and also confining the springs 7E between the guide track mount 7A and the backing plate 7B and, thus, the entire cushioning mount 7 has shock absorbing capability, the springs 7E absorbing shock from the force generated when force is applied to the workpiece 5 during bending such that the workpiece 5 is formed precisely at the expected angle of bend, with the workpiece surface remaining smooth and free of pressure marks.

The rod head 8A2 of the pressure cylinder mount 8 pressure cylinder 8A piston rod 8A1 is linked by means of an inserted pin 8D to the connecting rod assembly 8B and connecting rod assembly 8B connecting rod mount 8B3 upper end mount surface on which a plurality of bearings 8E are disposed, all having shock absorbing capability relative to the force generated when force is applied to bend the workpiece 5, uniformly dispersing the force exerted from the primary clamp block 3 to bend the workpiece 5 such that the

workpiece 5 is formed precisely at the expected angle of bend, with the workpiece surface remaining smooth and free of pressure marks, especially since the bearings are of wear-resistant, low hardness copper material construction that have durable and smooth shock absorbing capability that effectively provides for the accurate forming of the workpiece 5 at the expected angle of bend.

As described above, the invention herein has enhanced performance, especially because the primary clamp block 3 of the plate bending fixture 1 is rotated and the workpiece 5 is bent until the primary clamp block 3 is revolves to a top point where rotation ceases, such that after the workpiece 5 is formed into a product having the exact expected angle of bend, the workpiece surface remains smooth and free of pressure marks and, furthermore, misshaping and surface wear problems do not occur, with accurate control over the degree of precision, the quality of the finished workpiece 5 product is not affected and there are no fitting problems when assembled with other components.

In summation of the foregoing section, since the structure of the invention herein meets new invention application requirements, the present invention is submitted to the patent bureau for review and the granting of the commensurate patent rights.